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Directorate for Science, Technology and Industry of the Organization for Economic Cooperation and Development and the Institute for Statistics of the United Nations Educational, Scientific and Cultural Organization

Note by the Secretary-General

The Secretary-General has the honour to transmit the present report to the Statistical Commission in accordance with a request of the Commission at its thirty-eighth session.** The report, prepared by the Directorate for Science, Technology, and Industry of the Organization for Economic Cooperation and Development and by the Institute for Statistics of the United Nations Educational, Scientific and Cultural Organization elaborates the current and future plans in the area of science and technology statistics. The Commission is invited to take note of the report.

* E/CN.3/2008/1.

** See *Official Records of the Economic and Social Council, 2007, Supplement No. 4* (E/2007/24), chap. I.A.

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Report prepared by the Directorate for Science, Technology and Industry of the Organization for Economic Cooperation and Development and by the Institute for Statistics of the United Nations Educational, Scientific and Cultural Organization

I. Introduction

1. The present report has been produced in response to the regular request of the United Nations Statistical Commission on the status of science and technology statistics. The report outlines the current situation and highlights some challenges and selected future developments. It has been jointly prepared by the United Nations Educational, Scientific and Cultural Organization (UNESCO) Institute for Statistics and the Organization for Economic Cooperation and Development (OECD) Directorate for Science, Technology and Industry. There is increasing recognition of the importance of science in development, as emphasized in the reports of the Millennium Summit (2005), the Millennium Project and the Commission for Africa, to name but three recent initiatives. Statistics on science and technology are fundamental to an understanding of the processes by which development has an impact on societies and their economies, an impact which is very uneven across the world. In this report, science and technology statistics on research and development, innovation, human resources for science and technology, patents and general-purpose technologies such as biotechnology and nanotechnology are discussed. Concepts, classifications and methodologies employed in science and technology statistics need to be regularly updated to capture emerging scientific fields and technologies which may not easily fit into the existing frameworks and may be multidisciplinary (such as biotechnology and nanotechnology).

II. Modus operandi for work on science and technology statistics

A. UNESCO Institute for Statistics

2. The UNESCO Institute for Statistics is the lead agency in the United Nations system for science and technology data collection. It relaunched its science and technology statistics programme in 2004 (see E/CN.3/2004/15) after a worldwide consultation with Member States and experts.[1]

3. The main lines of action of the UNESCO Institute for Statistics in science and technology statistics are: survey operation and data guardianship; training and capacity-building in science and technology statistics; standard-setting and methodological development; and analysis and publications; in the framework of extensive collaboration and partnerships with national, regional and international governmental and civil-society organizations.

[1] See UNESCO Institute for Statistics strategy document UNESCO 2004, available at www.uis.unesco.org.

B. OECD

4. The work of OECD on science and technology statistics is conducted by the working party of the Committee for Science and Technology Policy, the National Experts on Science and Technology Indicators. The National Experts group is chaired by Statistics Canada and a bureau which currently includes Belgium, Finland, Italy, Japan and the United States of America. Working with the OECD secretariat, the bureau formulates a biennial schedule of projects which are reviewed, debated and prioritized by the Committee, eventually becoming part of its overall programme of work. In recent years, science and technology statistical activities have consistently ranked among the top priorities of the Committee, and science and technology methodologies, indicators and quantitative work have rated among the highest in terms of quality and impact across the whole organization. The National Experts group also conducts its own so-called Blue Sky activity to develop new indicators to respond to changing policy and user needs in the science and technology area. The latest Blue Sky II conference, held in Ottawa in September 2006,[2] reviewed progress and identified potential future work on science and technology statistics. A selection of conference papers is now part of a book entitled *Science, Technology and Innovation Indicators in a Changing World: Responding to Policy Needs*[3] aimed at the wider community. The National Experts group meets in a plenary session once a year, while task forces and workshops address, in a more focused way, particular issues. Currently task forces or ad hoc groups of the National Experts on Science and Technology Indicators are working on the internationalization of research and development, on research and development and national accounts; on research and development tax incentives; on patents statistics; on biotechnology statistics; and on the careers of doctorate holders. A new Committee working party on nanotechnology has been created. Delegates attending the National Experts' meeting represent the 30 OECD member countries, as well as five observer countries (Chile, China, Israel, the Russian Federation and South Africa), and there are also representatives from Eurostat, UNESCO, The Ibero-American Network on Science and Technology Indicators, and New Partnership for Africa's Development.

C. Other organizations

5. Eurostat has a joint research and development statistics collection with the OECD twice a year. It also collects innovation statistics by means of the Community Innovation Survey from the European Union and European Economic Area Member States, EU candidate countries and the Russian Federation. The Eurostat working party on research and development and innovation statistics is also involved in methodological work in various domains. It has worked closely with OECD in the revision of the *Oslo* and *Frascati Manuals* as well as other technical guidelines. The Community Innovation Surveys prepared and coordinated by Eurostat implement the Oslo measurement guidelines in a comparable way across EU countries. The development of the next Community Innovation Survey started in November 2007, and fieldwork will be launched in 2009.

6. Some other regions of the world have in recent years significantly improved their capacity for the production of science and technology statistics. In Latin

[2] See www.oecd.org/sti/blueskyconference.

[3] Paris, OECD, September 2007.

America, the Ibero-American Network on Science and Technology Indicators started its activities in 1995 under the auspices of the Ibero-American Program on Science and Technology for Development. The Ibero-American Network collects and publishes research and development and innovation statistics from Latin American countries, and is also active in studies relating to methodological issues and training at the regional level. In Africa, the African Ministerial Council on Science and Technology has just launched its African Science, Technology and Innovation Indicators Initiative, which includes the establishment of an African Observatory for Science, Technology and Innovation.

D. Publications and databases

7. The UNESCO Institute for Statistics provides research and development statistics to the United Nations Statistical Division (for the *United Nations Statistical Yearbook*), the United Nations Development Programme (*Human Development Report*), the World Bank (*World Development Indicators*) and other stakeholders. Its global research and development statistics database is available online at www.uis.unesco.org, and it has published thematic bulletins and fact sheets on topics such as the evolution of research and development expenditure in the world, the application of bibliometrics to developing countries and women in science and technology.

8. OECD publications on science and technology are available in hard copy and electronically (CD or via SourceOECD) and mirror the OECD databases. They include: the *Main Science and Technology Indicators*; *Research and Development Statistics (RDS)*, both produced biannually; and the Analytical Business Enterprise research and development database which is an analytical database where the OECD secretariat adjusts the data to correct for known anomalies and deficiencies in the official business enterprise research and development data. The Analytical Business Enterprise research and development database is produced both electronically and in hard copy form annually. Other publications in the science and technology area are the yearly Compendium of Patent Statistics and the biennial biotechnology statistics publication. In addition to these standard publications, OECD produces science and technology indicators in a number of other publications such as the *STI Scoreboard*, which provide a comprehensive picture of countries' innovation and performance in the global economy (see: www.oecd.org/sti/scoreboard).

9. For new and emerging work of both a statistical and a methodological nature, OECD increasingly uses its working papers series as a dissemination tool. Recent reports include studies on the labour characteristics and international mobility of doctorate holders, nanotechnology patents and patent nowcasting indicators (see: www.oecd.org/sti/working-papers).

10. Eurostat releases its research and development statistics under theme 9: Science and technology statistics in New Cronos.

III. Current Work & Future Challenges

11. There have been many significant changes in science statistics since the last UNESCO Institute for Statistics/OECD report to the United Nations Statistics Commission. The UNESCO Institute for Statistics has established a new global collection of research and development statistics. OECD has developed a

measurement framework in the area of biotechnology and is now starting a similar endeavour in the area of nanotechnologies. The National Experts on Science and Technology Indicators also held its second decennial Blue Sky conference on science and technology indicators; started a large-scale exploitation of innovation survey microdata; and is working with national accountants to provide guidelines for the capitalization of research and development in national accounts. The UNESCO Institute for Statistics, OECD and Eurostat have worked to harmonize methodologies, survey instruments and guidance to countries. As a result, there is a much greater volume of more comparable data than at the time of the previous report in 2004. It is expected that the next few years will see further improvements in the same direction, concentrating on improving the availability of data — more variables from more countries — as well as improving data quality through more harmonized methodologies.

A. Research and development statistics

International research and development data-collection activities

12. UNESCO has been collecting science and technology statistics from its member countries since the late 1990s. The UNESCO Institute for Statistics has now re-established a regular biennial global research and development survey, with the next survey planned for 2008. In order to avoid duplication in data collection, data-sharing agreements have been established with OECD, Eurostat and the Ibero-American Network. The questionnaire can be downloaded from the UNESCO Institute for Statistics website and data can be submitted electronically using a password-protected dynamic PDF questionnaire. The survey addresses 215 countries and territories, of which 138 have provided data. Most of the non-responding countries are small island developing States, or less developed countries, which often have less developed science and technology systems. The group of non-responding Arab States is also significant.

13. The UNESCO Institute for Statistics encourages countries to use the OECD Frascati international standard for research and development statistics. The UNESCO Institute for Statistics disseminates the Frascati methodology throughout the world, including its main definitions in the science and technology survey instruction manuals and discussing the details of its application in workshops. The UNESCO Institute for Statistics has been collecting evidence to compile a document on how developing countries can best apply the Frascati manual to meet their needs, doing so in wide consultation with experts, regional networks and national authorities.

14. The sixth edition of the OECD *Frascati Manual*, with an emphasis on research and development in service industries, was published in 2002. The OECD has collected research and development statistics for about 40 years for its member countries, and since 1997 has collected research and development data for selected non-member economies. Currently, the non-member economies covered in the main science and technology indicators are Argentina, China, Israel, Romania, the Russian Federation, Singapore, Slovenia, South Africa and Taiwan Province of China. Chile will be added in the near future.

15. In 2004, OECD and Eurostat signed a protocol of cooperation to reduce the burden on national statistical authorities by organizing a joint data collection of the research and development variables. Following that, a joint questionnaire was developed and a calendar agreed for two yearly data collections. Efforts were also

made to streamline the collection of related metadata. The ultimate objective of this exercise is for the two organizations to have databases that are fully compatible with each other.

Research and development and national accounts

16. The National Experts on Science and Technology Indicators played a key role in the latest revision of the System of National Accounts (1993, SNA) and the recent decision to change the treatment of research and development in the accounts from expenditure to investment. Research and development experts worked in cooperation with national accountants and experts in the Canberra II Group to examine practical issues relating to the implementation of this change and the requirements for constructing research and development satellite accounts, including coverage and valuation of research and development production, methods required for estimation at constant international prices, research and development imports/exports, constructing research and development stocks and estimating their depreciation, and overlaps in the data on research and development and software. The National Experts group will continue to work with the Working Party on national accounts in the preparation of a Handbook on deriving capital measures of intellectual property, which includes a chapter on research and development and the implementation of the new System of National Accounts requirements.

B. Innovation statistics and indicators

17. The latest revision of the joint OECD/Eurostat *Oslo Manual* on measuring innovation was published in 2005. The new concepts developed in the *Manual* (including marketing and organizational innovation) are now being implemented in innovation surveys across countries (including the Community innovation survey in Europe). The current *Oslo Manual* also includes an annex on Measuring innovation in developing countries developed by UNESCO with the assistance of the Ibero-American Network on Science and Technology Indicators, in consultation with experts from developing countries which have carried out innovation surveys. This annex suggests how non-OECD countries might use the *Oslo Manual* to measure the particular characteristics of innovation in their economies.

18. Eurostat launched the fourth Community Innovation Survey in 2005. Comparability of data between the third and fourth Community Innovation Surveys was improved in comparison with previous surveys. The fourth Community Innovation Surveys questionnaire was shorter and considerably less difficult than the third Community Innovation Surveys questionnaire.

19. More and more developing countries are currently collecting innovation statistics. The UNESCO Institute for Statistics hopes to launch a survey of innovation statistics in 2008.

Exploitation of innovation microdata at an international scale: the OECD innovation microdata project

20. This OECD project addresses the determinants and impacts of innovation at the firm level across countries. Its added value is its international scope: indicators and econometric estimates based on the same methodological approach were compiled in various countries so that cross-country comparisons could be conducted in a more reliable way than is possible now. The indicators include both standard

innovation indicators and more complex indicators of innovation modes and performance. The econometric analysis includes four topics: (a) innovation and productivity; (b) international technology transfer; (c) non-technological innovation; and (d) intellectual property rights. The size and industry of the business and the degree to which it is or is not multinational are taken into account. In 2006-2007, coordinated groups of experts in various countries ran similar statistical operations on their respective national microdata: cleaning, compiling indicators and applying econometric regressions. The core data came from innovation surveys, notably of the fourth Community Innovation Surveys type. This decentralized approach (whereby each national team works on its own data set) is required due to the confidential character of survey microdata sets. Results of this project and options for follow-up were discussed at two workshops in November 2007 and a report will be published in the first half of 2008.

Patent data

21. The outcomes and characteristics of research activities can also be captured by patent data. Patents have their own drawbacks, for instance, they miss out on the non-patented outcomes of the innovation process. At the OECD secretariat, work on patent statistics has focused on the following areas: (a) database, (b) methodology, (c) dissemination of patent statistics, and (d) organization of workshops on patent statistics. The OECD patent database includes patents from major patent offices in the world (Europe, Japan and the United States of America, as well as international filings, known as patent cooperation treaty applications. The database also includes data by region, industry, technical field (e.g., nanotechnology), patent holder name, and citations to patents. OECD is preparing a revised version of the patent manual, which includes documentation and guidelines for compiling patent indicators.

22. This activity is mainly supported (in terms of resources and expertise) by a task force composed of users and producers; the World Intellectual Property Organization, Eurostat, the European Commission Research Directorate General, the National Science Foundation United States of America and patent offices from Europe, Japan and the United States of America. This task force sponsored a series of patent statistics workshop that was co-organized by the OECD with the World Intellectual Property Organization and the European Patent Office. Data, indicators and methodological information are available on the OECD website: www.oecd.org/sti/ipr-statistics.

C. Biotechnology and nanotechnology

23. OECD has been developing biotechnology statistics since 2000 via its Ad Hoc Meeting on Biotechnology Statistics, working under the aegis of the National Experts on Science and Technology Indicators. The work of the Ad hoc meeting led to the development of a Framework for Biotechnology Statistics, comprising a statistical definition of biotechnology, a framework for collecting internationally comparable data on biotechnology, and a model questionnaire (http://www.oecd.org/dataoecd/5/48/34935605.pdf). In 2006, OECD released the 2006 edition of *OECD Biotechnology Statistics* (http://www.oecd.org/dataoecd/51/59/36760212.pdf). This edition includes data for 23 OECD countries and two observer countries, plus China (Shanghai), and represents a major step forward in improving the comparability of biotechnology indicators among countries. OECD also held two workshops on measuring the economic impacts of biotechnology (2004 and 2006). The purpose of

the 2006 workshop was to provide a forum for progress on measuring the socio-economic effects of biotechnology since the 2004 meeting, an assessment of measurement issues and an evaluation of the needs of the users of data on biotechnology impacts. Results from these three areas were then used to develop a framework for a future research programme to measure the diffusion and impacts of biotechnology.

24. An OECD Working Party on Nanotechnology was created under the Committee in Science and Technology Policy in March 2007. One of the areas under the mandate of the working party is nanotechnology statistics and measurement. The first workshop in November 2007 discussed available metrics in the area of nanotechnologies and user needs for indicators. Future steps will require the involvement of the National Experts with a view to creating an ad hoc group on nanotechnology statistics to serve the working party. The approach followed would be similar to the one used in OECD work on biotechnology statistics.

D. Human resources in science and technology

25. The migration of highly skilled people has continued to be a concern for all countries, to ensure that the most talented individuals have the greatest chance to make a contribution to the needs of all countries. In response to this, the UNESCO Institute for Statistics, OECD and Eurostat have developed a methodology to follow up on the careers of doctorate holders with the financial support of the United States National Science Foundation and of Eurostat for the EU countries. This methodology is now being widely applied in Europe and various OECD countries, as well as in some developing countries. A second data collection was launched in November 2007 and it is likely that data for some 20 countries will become available. The three partner organizations will also issue the methodology in a joint publication by the end of 2007 or beginning of 2008, to be widely promoted worldwide. If an increasing number of countries participate in this exercise, a comprehensive global database on the most talented people on the planet will be produced. While education statistics at the UNESCO Institute for Statistics give priority to basic education and the Millennium Development Goals, some attention has been given to higher education. A new data set on international student mobility was published in 2006, and UNESCO has launched the UNESCO Forum on higher education research and knowledge to coordinate information on higher education research in the knowledge society.

E. Statistical capacity-building

26. Statistical capacity-building is part of the core mandate of the UNESCO Institute for Statistics as established by UNESCO. In order to improve the availability and quality of science and technology statistics in various regions of the world, capacity-building and training are needed. The UNESCO Institute for Statistics has designed and delivered an extensive series of regional workshops between 2005 and 2007, addressing science and technology statisticians in 90 countries. These workshops were carried out in partnership with UNESCO headquarters, its regional offices, regional networks, funding agencies and other interested partners.

27. Workshops have taken place involving 90 developing countries in all regions of the world. The goals were to increase the number of countries regularly producing

quality science and technology indicators; to create local capacity for the production of such indicators; to promote evidence-based science and technology policymaking; to facilitate discussion between countries, addressing problems they may have encountered; to learn about the characteristics of science and technology statistics data collection and use in countries of the same region; and to identify examples of good practice to be shared with other countries. The workshops were targeted at the statisticians who do the data collection and analysis in each country, but have also included policy and decision makers from a variety of national authorities.

28. The success of the UNESCO Institute for Statistics statistical capacity-building activities depends significantly on funding raised from external sources, as the core budget of the UNESCO Institute for Statistics received from UNESCO can contribute only limited funding to such activities. The UNESCO Institute for Statistics is reliant on extrabudgetary funding from international and bilateral organisations which support the need of developing countries for quality data to inform policy and strategies for poverty reduction, economic development and monitoring of progress towards international objectives such as the Millennium Development Goals.

IV. Conclusion

29. Since the last report to the United Nations Statistical Commission, much has changed. UNESCO has reaffirmed its position as a global agency in this field, with its global research and development survey and numerous training activities worldwide. OECD and Eurostat have published the third edition of the *Oslo Manual*. OECD and Eurostat have initiated a joint data-collection exercise of research and development statistics. The joint development of the careers of doctorate holders methodology (OECD/the UNESCO Institute for Statistics/Eurostat) has opened a new area of research in this field.

30. Cooperation between the main agencies active in this area (UNESCO, the UNESCO Institute for Statistics, OECD and Eurostat) has been increasingly close, with some excellent results. Cooperation between international agencies and national statistics organizations has also been good, with active participation in both OECD and UNESCO activities. However, in developing countries, national statistics organizations are less involved in the area of science and technology statistics, with the line ministries taking the lead. National statistics organizations should be encouraged to get involved in order to improve data quality, since increasing policy emphasis on science and technology suggests a need for regular science and technology data collection in national statistical plans and strategies.

31. In many countries, increased resources are needed for the collection of timely and relevant science and technology statistics of high quality, based, where applicable, on international methodologies. The community of statisticians needs to work together to make a better case for the importance and relevance of such data.

32. International activities in this area involve multiple agencies (both international and regional), leading to risks of duplication or of varying demands for statistics. We are pleased to report that we are concentrating our efforts on cooperation and the avoidance of duplication of work in order to optimize the use of relatively scarce resources. This paper, produced jointly by UNESCO and OECD, with assistance from Eurostat, is an indication of the ongoing collaboration.

Annex

Methodological manuals and relevant documents

Type of data	*Title*
UNESCO	
Recommendation concerning the International Standardization of Statistics on Science and Technology, Paris, 1978	
Manual for Statistics on Scientific and Technological Activities (ST-84/WS/12), UNESCO, Paris 1984	
"Immediate, medium- and longer-term strategy in science and technology statistics", UNESCO Institute for Statistics, Montreal, 2003	
UNESCO Institute for Statistics website: http://www.uis.unesco.org	
OECD/Eurostat	
The Frascati family: *The Measurement of Scientific and Technological Activities* Series	
Research and development	*Frascati Manual 2002: Proposed Standard Practice for Surveys of Research and Experimental Development* (OECD, 2002)
Technology balance of payments	*Manual for the Measurement and Interpretation of Technology Balance of Payments Data — TBP Manual* (OECD, 1990)
Innovation	*Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data, 3rd edition* (OECD/Eurostat, 2005)
Patents	*Using Patent Data as Science and Technology Indicators — Patent Manual 1994* (OECD, OCDE/GD(94)114, 1994b). The Manual is under revision, the new version will be published in 2008.
Science and technology personnel	*The Measurement of Human Resources Devoted to Science and Technology — Canberra Manual* (OECD, 1995)
Other methodological frameworks for science and technology	
High technology	"Revision of High-technology Sector and Product Classification" (OECD, STI Working Paper 1997/2)
Bibliometrics	"Bibliometric Indicators and Analysis of Research Systems, Methods and Examples", by Yoshiko Okubo (OECD, STI Working Paper 1997/1)
Globalization	*OECD Handbook on Economic Globalisation Indicators* (OECD, 2005)
Biotechnology	*A Framework for Biotechnology Statistics* (OECD, 2005)